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Measurement Of Absorption Spectra (Optical Density *D*)

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Abstract: A number of experimental measuring devices were used for optical, magneto-optical and magnetic measurements of rare-earth orthoaluminates and garnets:
(a) Installation for measuring the spectra of the degree of MCPL and luminescence.
b) Modified single-beam spectrophotometer with continuous recording of the optical absorption signal.
Key words: crystal, spectrum, luminescence, absorption, transitions, wavelength, frequency, polarization, degree of polarization, radiation, research, ultrasound, infrared radiation.

In the measuring device used, it was possible to record the optical absorption spectra (or rather optical density D) of the *paramagnetic garnet TbYAlG (Tb*0.2Y2.8Al5O12) under study. In this case, a modified method of measuring the optical density (or absorption coefficient) was used. α), based on the principle of stabilization of the average current of the photodetector of a single-beam spectrophotometer, which made it possible to record absorption spectra in wide spectral intervals in a relatively simple way. A characteristic feature of this technique (see Fig. 1) is the fact that during the continuous recording of the analog signal on the measuring chart recorder when scanning along the wavelengths of the absorption spectrum (or rather optical density) of the sample under study, a signal proportional to the high voltage applied to the

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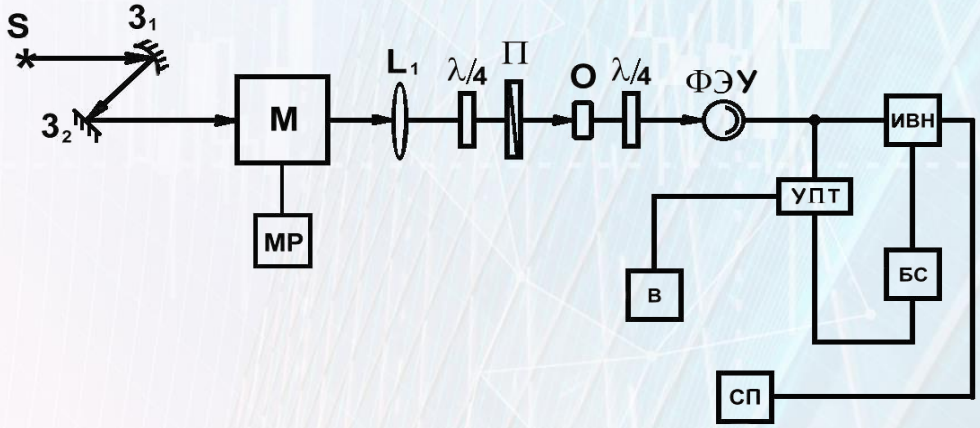
PMT dynodes is recorded. This signal, thanks to the introduction of feedback, uniquely corresponds to the illuminance of the PMT, which is determined by the optical density *D of the* measured sample. Possible departure of the "zero" line in the recording of absorption spectra, caused by changes in the transmission of the optical system, the emissivity of the light source and the spectral sensitivity of the PMT used, can be corrected by the appropriate selection of the continuous spectrum source and the type of photomultiplier, for which the change in the The "zero" of the record (with the output sample) does not exceed the permissible values (~1÷2% of the value of the average PMT current) in the studied wavelength range.

It is important to note that the sensitivity limit of single-beam spectrophotometers is significantly limited by fluctuations in the measured light fluxes. However, in the proposed measurement method, the role of this factor is insignificant, since, indeed, in the method of stabilizing the average current of PMTs, uncontrolled changes in the luminous flux are compensated by antiphase changes in the dynode voltage, which is actually equivalent to the introduction of negative feedback (by light flux) into the measuring channel of the spectrophotometer, which, as is known, contributes to greater linearity and reproducibility of measurement results.



Rice. 1. Schematic diagram of a modified single-beam spectrophotometer with continuous signal registration: S – light source; M – monochromator; Z1 – spherical; Z2 – flat mirror of the mirror illuminator; P – polarizer; L1 – collecting

lens, O – sample; PMT – photomultiplier; BS – PMT Medium Current Stabilization Unit; IVN – high voltage source (high-voltage rectifier); UPT – DC amplifier; B – digital voltmeter; SP – Chart Recorder; MR – Spectrum Sweep Motor.

In the single-beam spectrophotometer developed by us (based on the serial spectrophotometer MDR-23) with continuous signal registration, PMT-71 is used in combination with a light source - a DDS-30 lamp in the UV spectral region (and PMT-100 with a halogen incandescent lamp of 100 ~ W in the visible spectral region), for which the change in the zero line in the spectral ranges of 310÷420 nm and 470 650 nm÷, respectively, does not exceed ~1÷2% of the value of the average current of the PMT.

Stabilization of the average anode current of the photomultipliers used (with an accuracy of up to 1.2÷% when the illumination changes by more than two orders of magnitude) is carried out by transferring the high-voltage source BNVN-0.5 (or VS-22) from the voltage stabilization mode to the PMT current stabilization mode. Scanning of the studied absorption spectra (by wavelength) is carried out with a smooth rotation of the diffraction grating (~1200 *шт./мм*) performed by the scanning unit of the MDR-23 monochromator. During low-temperature measurements (at *T=78K) of absorption spectra, the studied samples were placed in a nitrogen bath of an optical cryostat installed in the monochromator sample compartment.*

The optical cryostat was an open bath (made of foam) in which a sample was placed and filled with liquid nitrogen. In order to prevent the passage of light through the sample by bubbles of boiling (and evaporating) liquid nitrogen in the vicinity of the sample, the latter is tightly clamped between two glazing glazing beads made of smooth quartz with polished (with high optical quality) facets.

One of them can be shifted towards the other (fixed fixed), as a result of which it is possible to smoothly adjust the gap between them depending on the thickness of the samples to be examined. Thus, the glazing glazing beads and the

specimen, tightly squeezed between them, form a kind of light conductor, and the fogging of the outer edges of the glazing beads, which occurs when the specimens are cooled, is eliminated by their heating by nichrome spirals connected to a DC source. Consumed in this case the power is quite small and does not exceed the total value of 10 watts. This cryostat is freely placed in the sample compartment attached to the MDR-23 (or SF-46) diffraction monochromator, and when poured with liquid nitrogen, the duration of measurements is provided for 1 ~hour.

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